UNITED STATES PATENT AND TRADEMARK OFFICE

C/L

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|---|---|---|---|---|
| 09/584,739 | 06/01/2000 | Kuniko Kikuta | PF-2622/NEC/US/mh | 3028 |

21254 7590 03/10/2004

MCGINN & GIBB, PLLC
8321 OLD COURTHOUSE ROAD
SUITE 200
VIENNA, VA 22182-3817

| EXAMINER | |
|---|---|
| QUACH, TUAN N | |
| **ART UNIT** | **PAPER NUMBER** |
| 2814 | |

DATE MAILED: 03/10/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

| Office Action Summary | Application No. | Applicant(s) | |
|---|---|---|---|
| | 09/584,739 | KIKUTA, KUNIKO | |
| | Examiner | Art Unit | |
| | Tuan Quach | 2814 | |

*-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --*

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

1)☒ Responsive to communication(s) filed on *18 December 2003*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

4)☒ Claim(s) *1,2,4,6,8-12,16,20-22,24,30,32 and 34* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,2,4,6,8-12,16,20-22,24,30,32 and 34* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

**Application Papers**

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *01 June 2000* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

## DETAILED ACTION

Claims 9, 20 and 21 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 9 depends from a cancelled claim.

"The interconnection layer" in claims 20 and 21 line 1 lacks antecedent basis.

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1, 2, 4, 6, 8, 9, 12, 16 are rejected under 35 U.S.C. 102(b) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over Akutsu et al. (Akutsu) of record.

Regarding claims 1, 2, 12, 16 Akutsu teaches forming copper alloy lead conductive material comprising copper alloy including 0 to 1% by weight of one or more material selected from Si, P, Ti between 0.05 and 1% and 0 to 2% by weight of Mo, W, Ta. See column 2 lines 1-11, column 3 lines 1 to column 4 line 37, particularly column 3 lines 1-11, lines 31-41, column 4 lines 7-15, Tables 1-6, wherein the specificity of the

composition ranges are delineated. Regarding claims 4, 6, 8, 9, 12, 16, in addition to the recitations above, the inclusion of Cr or Ni and Mg is also taught in Akutsu, column 2 lines 3-5, lines 54-55, column 3 lines 5-11, lines 25-30, Tables 1-6. Note that where applicant claims a composition in terms of a function, property or characteristic and the composition of the prior art is the same as that of the claim but the function is not explicitly disclosed by the reference, the examiner may make a rejection under both 35 U.S.C. 102 and 103, expressed as a 102/103 rejection. "There is nothing inconsistent in concurrent rejections for obviousness under 35 U.S.C. 103 and for anticipation under 35 U.S.C. 102." In re Best, 562 F.2d 1252, 1255 n.4, 195 USPQ 430, 433 n.4 (CCPA 1977). This same rationale should also apply to product, apparatus, and process claims claimed in terms of function, property or characteristic. Therefore, a 35 U.S.C. 102/103 rejection is appropriate for these types of claims as well as for composition claims.

Furthermore, although the claims do not recite the functional limitations of "so as to increase a crystal grain size and reduce crystal grain boundaries," e.g., claim 1 line 3-4 and "wherein said at least one of Mo, Ta and W being higher in density than copper is present on said crystal grain boundaries, whereby said at least one of Mo, Ta and W suppresses a diffusion of copper" as in, e.g., claims 1, 12, the last three lines, or the limitation regarding the suppression of mass transfer of copper, e.g., claim 12 line 4, the claims are not patentable over Akutsu since as the claimed composition is anticipated by the conductive material taught by Akutsu as delineated above. Note that while features of an apparatus may be recited either structurally or functionally, claims directed to an apparatus must be distinguished from the prior art in terms of structure

rather than function. In re Schreiber, 128 F.3d 1473, 1477-78, 44 USPQ2d 1429, 1431-32 (Fed. Cir. 1997) (The absence of a disclosure in a prior art reference relating to function did not defeat the Board's finding of anticipation of claimed apparatus because the limitations at issue were found to be inherent in the prior art reference); see also In re Swinehart, 439 F.2d 210, 212-13, 169 USPQ 226, 228-29 (CCPA 1971); In re Danly, 263 F.2d 844, 847, 120 USPQ 528, 531 (CCPA 1959). "[A]pparatus claims cover what a device is, not what a device does." Hewlett-Packard Co. v. Bausch & Lomb Inc., 909 F.2d 1464, 1469, 15 USPQ2d 1525, 1528 (Fed. Cir. 1990) (emphasis in original).
In addition, the claimed invention would have been further inherent and obvious since the composition is taught including the corresponding element of Mo, Ta, and W by Akutsu as delineated, therefore Akutsu must necessary exhibit the properties including the property that is associated with Mo, Ta, and W since the same elements are taught in Akutsu, absent evidence to the contrary. It is well settled that "[t]he PTO can require an applicant to prove that the prior art products do not necessarily or inherently possess the characteristics of his [or her] claimed product. Whether the rejection is based on inherency' under 35 U.S.C. 102, on prima facie obviousness' under 35 U.S.C. 103, jointly or alternatively, the burden of proof is the same...[footnote omitted]." The burden of proof is similar to that required with respect to product-by-process claims. In re Fitzgerald, 619 F.2d 67, 70, 205 USPQ 594, 596 (CCPA 1980) (quoting In re Best, 562 F.2d 1252, 1255, 195 USPQ 430, 433-34 (CCPA 1977)).

Insofar as the claimed ranges are not identical to those taught by Akutsu, such would have been obvious since it is well settled that in the case where the claimed

ranges "overlap or lie inside ranges disclosed by the prior art" a prima facie case of obviousness exists. In re Wertheim, 541 F.2d 257, 191 USPQ 90 (CCPA 1976); In re Woodruff, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir. 1990) (The prior art taught carbon monoxide concentrations of "about 1-5%" while the claim was limited to "more than 5%." The court held that "about 1-5%" allowed for concentrations slightly above 5% thus the ranges overlapped.); In re Geisler, 116 F.3d 1465, 1469-71, 43 USPQ2d 1362, 1365-66 (Fed. Cir. 1997) (Claim reciting thickness of a protective layer as falling within a range of "50 to 100 Angstroms" considered prima facie obvious in view of prior art reference teaching that "for suitable protection, the thickness of the protective layer should be not less than about 10 nm [i.e., 100 Angstroms]." The court stated that "by stating that suitable protection' is provided if the protective layer is about' 100 Angstroms thick, [the prior art reference] directly teaches the use of a thickness within [applicant's] claimed range."). Additionally, a prima facie case of obviousness exists where the claimed ranges and prior art ranges do not overlap but are close enough that one skilled in the art would have expected them to have the same properties. Titanium Metals Corp. of America v. Banner, 778 F.2d 775, 227 USPQ 773 (Fed. Cir. 1985) (Court held as proper a rejection of a claim directed to an alloy of "having 0.8% nickel, 0.3% molybdenum, up to 0.1% iron, balance titanium" as obvious over a reference disclosing alloys of 0.75% nickel, 0.25% molybdenum, balance titanium and 0.94% nickel, 0.31% molybdenum, balance titanium.). "[A] prior art reference that discloses a range encompassing a somewhat narrower claimed range is sufficient to establish a

prima facie case of obviousness." In re Peterson, 315 F.3d 1325, 1330, 65 USPQ2d 1379, 1382-83 (Fed. Cir. 2003).

In any event, the optimization of the appropriate composition would have been obvious to one skilled in the art to obtain the advantages cited in Akutsu including the optimization of electrical conductivity, heat resistance, improved strength, desired grain size, as delineated therein, e.g., column 2 lines 13-23, lines 50-53, column 3 lines 5-10, lines 35-39, 45-50, column 4 lines 11-15, and since it is well-settled that "where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation." In re Aller, 220 F.2d 454, 456, 105 USPQ 233, 235 (CCPA 1955). See also Peterson, 315 F.3d at 1330, 65 USPQ2d at 1382 ("The normal desire of scientists or artisans to improve upon what is already generally known provides the motivation to determine where in a disclosed set of percentage ranges is the optimum combination of percentages.")

Claims 10, 11, 20-22, 24, 30, 32, and 34 rejected under 35 U.S.C. 103(a) as being unpatentable over Akutsu taken with Dubin or Adelstein et al. (Adelstein) of record.

The reference as applied above does not recite the conventional structure supporting such interconnect to semiconductor devices, e.g., the provision of insulation and interconnect in an opening with or without barrier therein as in claims 10, 11, 22, 30, 32, 34. The copper alloy including the appropriate composition is anticipated or otherwise obvious over Akutsu as delineated above.

Edelstein teaches copper alloys, e.g., column 6 line 10 to column 8 line 50 wherein copper alloys including various materials, e.g., B, P, Ni, Ag, and various metals, such as Mo, W, Si, Ge, Ta, to obtain improved electromigration resistance. Alloys such as Cu(Ti) are also delineated. See column 8 lines 29 to column 9 line 3 wherein the inclusion of material such Ag and of Mo, W, is also delineated. Application of such materials on the via hole in semiconductor devices including underlying barrier is also shown.

Dubin teaches the use of copper alloys including in via contact holes, e.g., trench 12, including barrier 52, e.g., column 7 lines 7-21, including alloy layers 56, 57, the alloys being suitable Cu alloys including alloys of Cu with any of various metals, wherein the alloys can also include various alloying elements, e.g., Ni, Ag, etc. See column 5 line 30 to column 6 line 50.

It would have been obvious to one skilled in the art to have employed the copper alloy for interconnects in semiconductor devices including through insulation and barrier as taught by Edelstein and Dubin wherein contacts or interconnects can be made to desired portions of the semiconductor substrate as taught by Edelstein or Dubin. Conversely, Edelstein or Dubin as applied above teaches the interconnect structure to semiconductor devices and do not recite the particular copper alloy compositions. Akutsu is applied as above. It would have been obvious to have employed in Edelstein or Dubin the copper alloy conductive material taught by Akutsu because such copper alloy material and composition is conventional and advantageous as delineated above regarding Akutsu above, and also at column 1 lines 7 to column 2 line 36.

Applicant's arguments with respect to claims 1, 2, 4, 6, 8-12, 16, 20-22, 24, 30, 32, and 34 have been considered but are moot in view of the new ground(s) of rejection.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to examiner Quach whose telephone number (571)272-1717. The examiner can normally be reached on M - F from 9 to 5.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor Wael Fahmy can be reached on (571)272-1705. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (571)272-1562.

Tuan Quach
Primary Examiner